

A New Device for the Treatment of Coloproctostomic Stricture After Double Stapling Anastomoses

Shinya Shimada, M.D.,* Masakazu Matsuda, M.D.,† Keisuke Uno, M.D.,*
Housei Matsuzaki, M.D.,* Seiichi Murakami, M.D.,* and Michio Ogawa, M.D.*

From the Department of Surgery II, Kumamoto University Medical School, and the Department of Surgery, Kumamoto City Hospital,† Kumamoto, Japan*

Objective

A new device of staple cutter was developed to evaluate the clinical effect for the treatment of rectal stricture after the double stapling anastomosis.

Summary Background Data

The double stapling technique has become an established reconstruction method for patients with low anterior resection. The major complication of anastomotic stricture associated with circular stapling has been reported to be harmful and distressing. Because underlying mechanisms of stricture are not well understood, no prophylactic means have been developed and this results in postoperative dilation still being the only treatment available. Although various dilation methods are used for the treatment of stricture, none is fully satisfactory.

Methods

Low anterior resection was performed in 30 patients with rectal carcinoma using a double stapling technique. First, the incidence of the anastomotic stricture and the clinical factors that contribute to the stricture formation were studied. Second, the clinical effects and advantages of the treatment of coloproctostomic stricture using the newly developed device (staple cutter) were evaluated.

Results

Nine (30%) of 30 patients had anastomotic stricture with the symptom of distressing frequent bowel movement. There was no significant relation between the clinical factors and the stricture when compared with that of nonstricture patients. Excellent dilation was performed in all of the nine strictures using the staple cutter, and the symptom of stricture disappeared dramatically in eight patients (89%) within 1 week. The recurrence of stricture occurred in two patients; however, it has not been observed after one further use of this treatment. The staple cutter is safe and easy to use even at the bedside, and except for a conventional anoscope, no special equipment, including fluoroscope, was needed.

Conclusions

From the significant effects and advantages, the procedure using staple cutter is recommended highly for the treatment of circular stapling anastomotic stricture of the rectum.

Although circular stapling anastomosis of the rectum has been used widely and has been regarded as a safe and quick technique, the development of frequent anastomotic strictures is the major postoperative complication of this procedure.¹⁻⁸ It has been reported that the circular stapled anastomosis has a higher stricture rate than a handsewn anastomosis in the colon.⁹⁻¹¹ The incidence of the stricture when using an end-to-end anastomosis stapler has been reported as varying from 0% to 30%.³⁻⁸ An improved stapling technique for low anterior resection, that is, double stapling technique, overcoming the problems of insertion of the purse-string on the rectum stump and of disparity in size between the rectum and colon was introduced by Knight and Griffen¹² in 1980. This technique has been regarded to be also safe and quicker than the usual purse-string stapling technique.^{13,14} However, there hardly have been any reports concerning the complication of anastomotic stricture after the double stapling technique.

The complication of anastomotic stricture associated with stapling is harmful and distressing for patients with low anterior resection of the rectum. Dilation is the only treatment and is used variously with techniques such as digital, a sigmoidoscope, an esophageal dilator, or balloon dilators.^{3-8,14,15} These techniques, however, have their drawbacks, that is, digital or sigmoidoscopic dilation has insufficient effects, and esophageal and balloon dilators need fluoroscopy and other optional types of equipment, and recurrence is common.

We experienced a patient who had been suffering from frequent defecation (more than 10 times a day) for 3 months because of the circular stapling anastomotic stricture after coloproctostomy. This patient was relieved dramatically from the stricture and its symptom after natural loss of the part of the staple ring, and no further recurrence of stricture has been observed. Through this case, we concluded that staple cutting followed by digital dilation might be effective on the anastomotic stenosis caused by a circular stapler. We surmised that the circular stapling anastomoses may have different mechanisms in the formation of stricture from those of handsewn anastomoses. Dilators can dilate the deformed and shrunk staple line caused by the thickened circumferential scar formation but hardly split the closed staple line, resulting in reverting to the shape before dilation followed by a restructure. Thus, a new device of "staple cutter" was developed to split the circular staple line in the stricture.

In this article, we introduce this new device of staple

cutter, its clinical use, and the clinical effects and advantages. In addition, from the detailed postoperative follow-up, the incidence of stricture and clinical factors that are supposed to influence the formation of stricture after the double stapling technique is studied.

PATIENTS AND METHODS

Patients

From December 1993 to July 1995, 30 patients with adenocarcinoma of the rectum underwent low anterior resection and low colorectal anastomosis by a double stapling technique using TLH-60 (Johnson & Johnson Co., Ethicon, Cincinnati, OH) and PCEEA (United States Surgical Corporation, Norwalk, CT) and were observed at least twice a month until January 1996. We had no clinically evident anastomotic leaks and no intra-abdominal abscess. There were no significant complications related to surgical techniques. The patients were divided into two groups: 1) stricture and 2) nonstricture groups. The rectal stricture was defined as the inability to pass a 12.3-mm sigmoidoscope (CF-P 20S, OLYMPUS, Tokyo, Japan) through the stenosis.

Staple Cutter

We developed a new device named staple cutter for the purpose of removal of rectal stricture after the coloproctostomy with a circular stapling technique. As shown in Figure 1, the staple cutter is so simple and consists of two 3-mm sharp edges and a handle. The total length of the device is 24.0 cm, and the head was made as small as possible to pass the anastomotic stenosis (6 mm wide).

Staple Cutting

Staple cutting was performed on patients with the stricture of coloproctostomy with the staple cutter and dilated digitally at the bedside, mainly at the outpatient clinic. Using an anoscope with electric light (20 mm in diameter, 90 mm in length), two feasible sites (usually opposite sites) of the stricture were cut with the staple cutter under direct vision, as shown in Figure 2. Successfully, complete staple cutting was examined and dilation was performed digitally. The complete staple cutting made dilatation of the stricture digitally very easy. After the treatment of staple cutting and digital dilation, the stricture less than 12.3 mm in diameter expanded to more than 20 mm compared with the diameter of an anoscope. No perforation or significant bleeding during or after the treatment or both was observed. The first trial was done at 100 postoperative days for fear of causing perforation. However, as each subsequent treatment

Address reprint requests to Michio Ogawa, M.D., Department of Surgery II, Kumamoto University Medical School, 1-1-1 Honjo, Kumamoto 860, Japan.

Accepted for publication March 14, 1996.

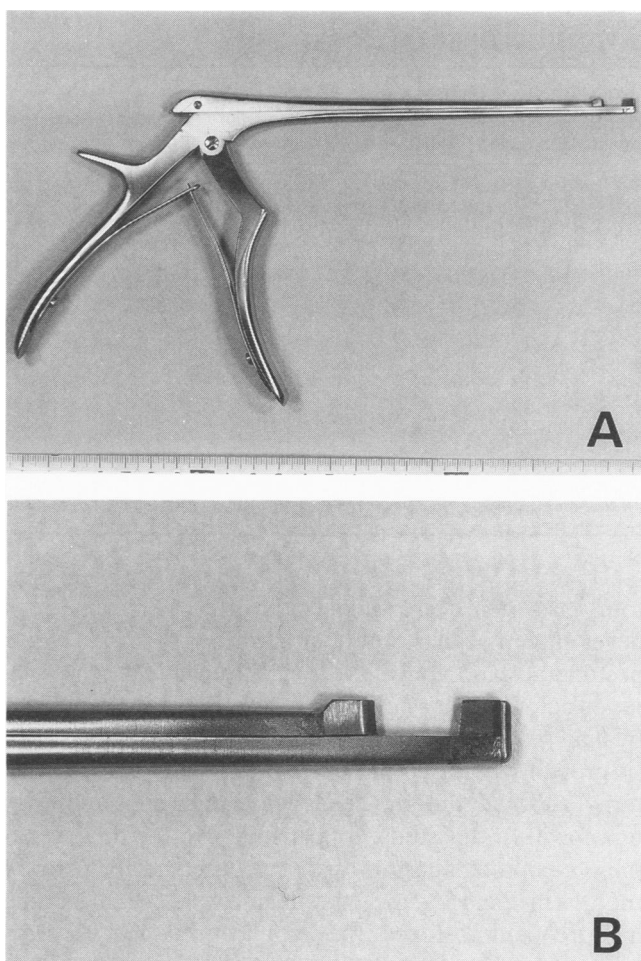


Figure 1. A new device of "staple cutter" (A) and the cutting head (B). This device was developed for the treatment of colorectal stenoses after the circular stapling anastomoses including the double stapling technique.

with staple cutting proved so successful, the postoperative treatment period became more shortened, with the shortest one being done at 23 postoperative days.

Statistical Analysis

Statistical analysis was performed using Student's *t* test and Fisher's exact probability test.

RESULTS

Incidence and Factors of Stricture

The anastomotic stricture was observed in 9 (30%) of 30 patients in this study (Table 1). All the patients with stricture had the symptom of frequent bowel movement. Among the nonstricture group, temporary frequent defecation was observed in 10 patients (47%). It disappeared within 30 postoperative days in almost all patients. Com-

pared with nonstricture group, there were no significant relation of gender, age, tumor stage, end-to-end anastomosis size, distance of anastomosis from the anal verge, or timing of postoperative diet in the stricture group (Table 2). For one instance of evaluation of blood supply to the anastomosis, we compared the incidence of stenosis between devascularization and preservation of the inferior mesenteric artery. However, there was no relation between them (Table 2).

Effects of Staple Cutting

The coloproctostomic stricture, which thickened with circumferential scar formation, was observed in all nine cases. It was hardly possible to dilate digitally. Using the staple cutter, two sites of the stricture including the staple were cut and then dilated digitally (Fig. 3). In all nine cases, this procedure enabled us to obtain sufficient dilation more than 20 mm in diameter compared with the diameter of the anoscope. Complications such as perforation or significant bleeding or both were not observed in any case. Figure 4 shows the number of defecation before and after staple cutting. It was significantly ($p < 0.001$) decreased after the treatment.

Clinical Course After Staple Cutting

As shown in Figure 5, except for three patients (cases 2, 4, and 8), a single staple cutting and digital dilation treatment succeeded in decreasing significantly the number of bowel movements within 1 week, and the occurrence of re-stricture has not been observed. In cases 4 and 8, the re-stricture and symptom occurred after 10 and 144 weeks from first cutting, respectively, although the first treatments were effective in both cases. The second cutting showed that the first treatment had not been able to split one of the cutting sites completely (case 8). Case 4 needed a second cutting and digital dilation 17 weeks af-

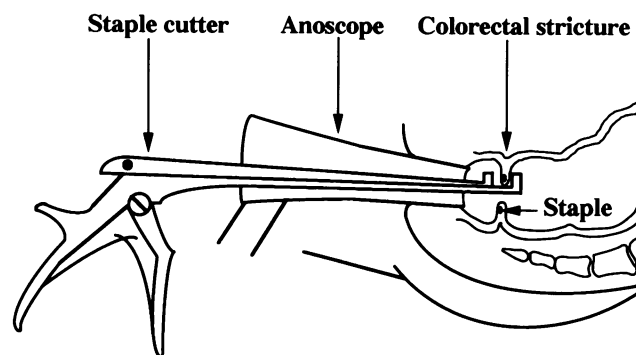


Figure 2. Presentation of a staple cutting technique. The two sites of a colorectal stricture are cut using the staple cutter assisted by a conventional anoscope.

Table 1. SUMMARY OF NINE PATIENTS WITH COLORECTAL STRICTURE

Patient No.	Sex	Age (yr)	Stage (Dukes')	Resected Artery	EEA Size (mm)	Anastomosis* (cm)	Staple Cutting† (wk)	No. of Defecations		Therapeutic Success	Repeated Cutting	Follow-up (mo)
								Precutting	Postcutting			
1	F	61	A	SRA	31	4	14	11	3	Yes	0	24
2	M	70	B	IMA	31	5	7	12	11	No	0	23
3	F	69	C	IMA	31	4	9	13	4	Yes	0	18
4	M	50	B	IMA	31	5	7	14	3	Yes	1	15
5	F	53	B	IMA	31	4	6	14	5	Yes	0	12
6	F	40	A	SRA	31	4	6	16	4	Yes	0	10
7	F	68	B	IMA	31	8	3	12	4	Yes	0	10
8	M	73	A	SRA	28	5	14	13	4	Yes	1	9
9	M	72	A	SRA	31	6	3	12	5	Yes	0	6

SRA = superior rectal artery; IMA = inferior mesenteric artery; EEA = end-to-end anastomosis stapler.

* Distance from anal verge.

† Postoperative weeks of staple cutting.

ter the first cutting. In the remaining case, case 2, the symptom of frequent defecation had continued for approximately 120 postoperative days, although the sufficient dilation was obtained by the staple cutting at postoperative day 28, and no anastomotic resticture has been observed.

DISCUSSION

With the advance of surgical techniques and the circular staple device, the incidence of leakage of coloproctostomy has been decreasing significantly.

Conversely, the development of anastomotic stricture has become a major postoperative complication.^{8,12,16,17} Luchtefeld et al.⁸ surveyed colorectal anastomotic stenosis in the United States by mail and stated that large intestinal anastomotic stenosis probably occurred most commonly after coloproctostomy, although the true incidence of the stenosis still was unknown. In this study, 30 patients with the double stapling coloproctoanastomosis were observed for 6 to 24 months in detail and the stricture rate was 30%, suggesting high frequent postoperative complication after coloproctoanastomosis by using the double stapling technique.

Blood flow, leakage and infection, inflammatory response of the anastomotic materials, circular stapler size, and fecal contact to anastomosis have been proposed as the factors that may contribute to the formation of anastomotic stricture of colorectal anastomosis.¹⁸⁻²² In the present study, the clinical leakage and infection were not observed in any of the 30 patients. The double stapling technique was performed with the same instruments in all patients, and the size of the end-to-end anastomosis cartridge was 31 mm with one exception (28 mm) for each stricture and nonstricture group. Concerning the blood supply, Orsay et al.¹⁹ concluded that clinically relevant ischemia does not directly influence stricture formation in either handsewn or stapled colonic anastomosis. We also could not find any difference between the devascularization of the inferior mesenteric artery and the anastomotic stricture. An experimental study has been done to compare the incidence of anastomotic stricture between stapling anastomosis and layer-to-layer, handsewn anastomosis with or without contact with feces. The anastomotic strictures have developed significantly in stapling anastomosis without fecal contact.²⁰ In this study, there was no difference in the timing

Table 2. COMPARISON OF CLINICAL FACTORS BETWEEN STRICTURE AND NONSTRICTURE GROUPS

	Stricture (n = 9)	Nonstricture (n = 21)
Sex		
Male	4	11
Female	5	10
Age (yr)	60.5 ± 11.7	64.0 ± 6.8
Tumor stage		
Dukes' A	4	8
Dukes' B	4	6
Dukes' C	1	7
Devascularization		
IMA	5	16
SRA	4	5
EEA size		
31 mm	8	20
28 mm	1	1
Distance from anal verge (cm)	4.8 ± 1.3	5.0 ± 0.9
Timing of diet (days)	9.8 ± 2.1	10.8 ± 4.7
Follow-up (mo)	15.1 ± 6.0	14.8 ± 5.5

IMA = inferior mesenteric artery; SRA = superior rectal artery; EEA = end-to-end anastomosis stapler.

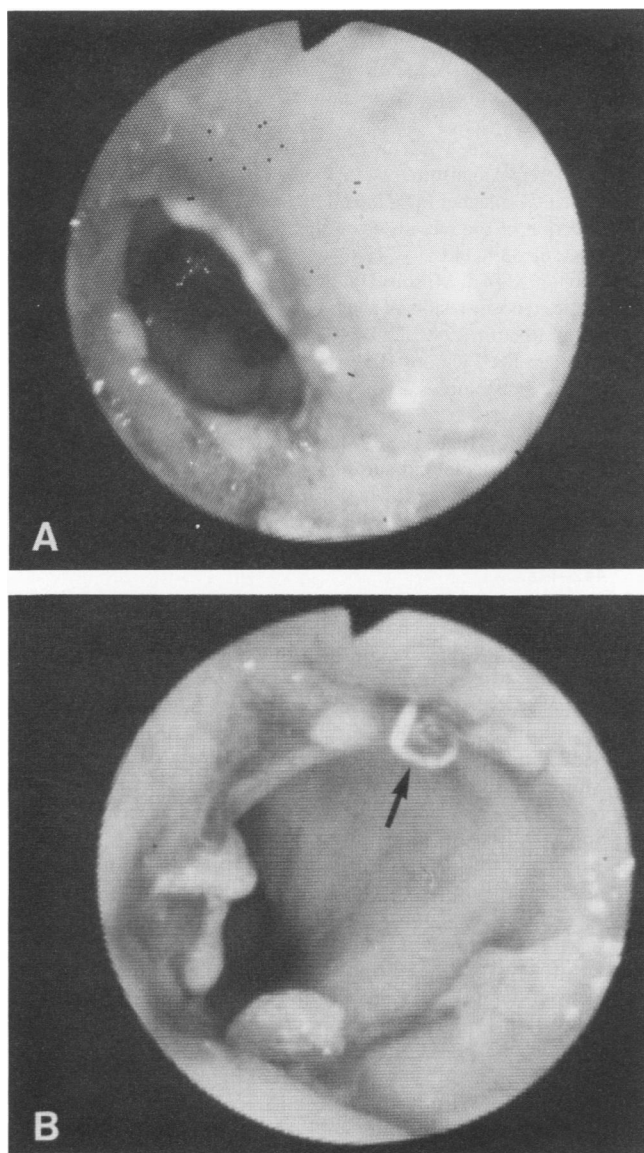


Figure 3. Endoscopic evaluation of the effect of staple cutting before (A) and after (B) cutting. Just two staple cuttings enabled us to dilate easily the stricture to more than 20 mm in diameter compared with anoscope width. The exposed staple (arrow) indicates complete cutting of the staple line.

for starting to eat between the stricture and nonstricture group. These results indicate that there are no obvious clinical factors that contribute to the formation of anastomotic stricture after the double stapling technique and that there are no prophylactic means for the stricture at time of surgery and perioperatively.

The symptoms of frequent bowel movement and sense of residual stool followed by anal pain due to anastomotic rectal stricture are so harmful and distressing that immediate symptomatic relief of the stricture greatly contributes to the quality of a patient's life after

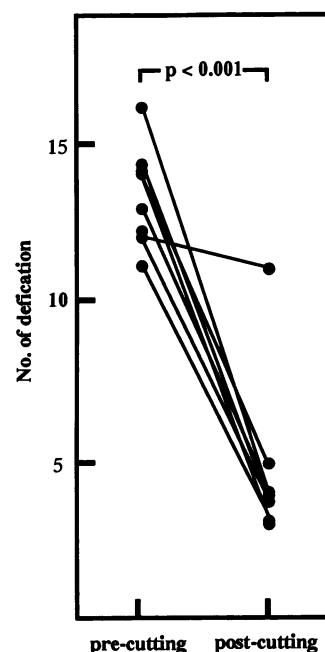


Figure 4. Clinical effect of the staple cutting. The symptom of frequent defecation ($p < 0.001$) decreased significantly after the treatment.

the coloproctostomy. As summarized in Table 1, the treatment of anastomotic stricture by the staple cutting followed by digital dilation was tremendously effective. Only a single treatment procedure enabled us to dilate the less than 12.3 mm of stricture to more than 20 mm in all nine patients and cleared the distressing symptom of frequent defecation dramatically in eight (89%) of nine patients. Despite the successful dilation in case 4, the symptom had continued for 90 days after the treatment. Postoperative dysfunction due to low anterior resection other than the stenosis may have affected the

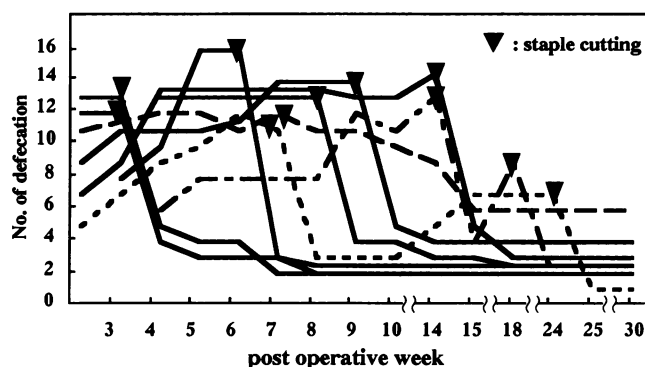


Figure 5. Clinical course of the stricture group. The effect of staple cutting was obtained within 1 week in all cases except one, case 2 (long dotted line). In case 2, the symptom continued despite the sufficient dilation obtained by the treatment. Only two patients, case 4 (dotted line) and case 8 (broken line), needed one further cutting to dilate the restricture.

symptom of this case, possibly because of reduced pre-serving capacity of stool in the proximal colon above the anastomosis.

The notable advantage of this treatment is the low rate of restructure. Just a single staple cutting performed complete dilation of the stricture without no restenosis in seven (77%) of nine patients. The other major effective treatments have been those with esophageal or balloon dilators. However, it has been reported that repeated dilation has often been needed for the restructure.^{16,17,23} The closed circular staple ring may have an accelerated effect on the formation of anastomotic restructure, that is, the staple ring deformed and shrunk with the thickened and circumferential scar may return to what was before dilation as long as the circular staple line remains tightly. Endoscopic incision for the treatment for membranelike stenoses in the upper gastrointestinal has been reported and used.^{24,25} In this procedure, the membranelike stenoses have been removed by repeated incision using diathermic cutter to obtain a wide lumen. Unlike the diathermic cutting, which needless to say is not able to cut the staple, the staple cutter needs to cut only two sites of the stricture, supporting our opinion on the mechanisms of restructure characteristic in the circular stapling anastomoses, as described above.

This device is so simple, easy to use under direct vision with the use of a conventional anoscope, and does not need fluoroscope or other special optional equipment. This treatment generally was performed at the bedside, even in the outpatient clinic, and the significant complications, such as bleeding or perforation or both, have not been observed. Thus, the treatment using this newly developed device is recommended strongly for the removal of the stricture after the coloproctostomy with circular stapler. We now are trying to cut the staple as early as possible to free the patients from such distressing symptoms.

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